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Ionospheric mapping functions based on electron density fields

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We developed an ionospheric Mapping Function (MF) for the Global Navigation Satellite System (GNSS) which is based on the electron density field of the International Reference Ionosphere (IRI). The station specific MF utilizes a look-up table which contains a set of ray-traced ionospheric delays. Hence, unlike the simple MFs that are currently in use, the developed MF depends on the time, location, elevation and azimuth angle. Ray-bending is taken into account, which implies that the MF depends on the carrier frequency as well. This frequency dependency of the MF can be readily used to examine higher-order ionospheric effects due to ray-bending. We compare the proposed MF with the so-called single layer model MF and find significant differences in particular around the equatorial anomaly. In so-far as the proposed MF is based on a realistic electron density field (IRI) our comparison shows the potential error of the single-layer model MF in practice. We conclude that the developed MF concept might be valuable in the GNSS Total Electron Content estimation. The frequency dependency of the MF can be used to mitigate higher-order ionospheric effects.